CLAIMS

What is claimed is:

1. An internal combustion engine system, comprising:

an internal combustion engine including an exhaust manifold with an exhaust outlet and an intake manifold with an air inlet;

an engine exhaust conduit in fluidic connection with the exhaust outlet and the inlet of a first control valve with one inlet and two outlets;

a high pressure exhaust gas recirculation (EGR) fluidic connection between a first outlet of the first control valve and the air inlet of the intake manifold;

a turbocharger having an exhaust gas turbine with an input in fluidic connection with a second outlet of the first control valve and with an output, the turbocharger further having a compressor with an input and an output;

an EGR supply conduit in fluidic connection with the output of the exhaust gas turbine and a fresh air inlet in fluidic connection with the input of the compressor, with a second control valve disposed along the EGR supply conduit; and

an intake manifold conduit in fluidic connection with the output of the compressor and the air inlet of the intake manifold.

2. The engine system of claim 1, further comprising a control, the control operating the first control valve and the second control valve to determine whether exhaust gas will enter the air inlet of the intake manifold by means of the high pressure EGR fluidic connection, by means of the intake manifold conduit, or by both.

3. The engine system of claim 2, further comprising at least one sensor, the at least one sensor sensing at least one operating parameter selected from the group that includes the quantity of fuel flow to the engine, the engine speed of the engine, air flow at one or more points within the engine system, exhaust gas turbine speed, compressor pressure ratios, engine operating temperature, and air temperature.

4. The engine system of claim 1, further comprising an EGR cooler disposed along the high pressure EGR fluidic connection at a point downstream of the control valve and upstream of the air inlet.

5. The engine system of claim 1, further comprising an air cooler disposed along the intake manifold conduit at a point downstream of output of the compressor and upstream of the air inlet of the intake manifold.

6. The engine system of claim 1, wherein the turbocharger comprises a variable geometry turbocharger.

7. The engine system of claim 1, further comprising an EGR mixer with two inlets, providing a first inlet intake manifold conduit fluidic connection and a second inlet high pressure EGR fluidic connection, with the outlet in fluidic connection with the air inlet of the intake manifold.

8. The engine system of claim 7, wherein the EGR mixer comprises a proportioning gas control valve, to mix controlled proportions of the combined compressed air and exhaust gas from the intake manifold conduit with exhaust gas from the high pressure EGR fluidic connection.

9. The engine system of claim 1, further comprising an emissions controller with an input and output, the input of the emissions controller being in fluidic connection with the output of the exhaust gas turbine, and the output being in fluidic connection with the EGR supply conduit.

10. The engine system of claim 9, wherein the emissions controller comprise one or more of a diesel particulate filter, a diesel oxidation catalyst, a lean NOx trap, and a selective catalytic reduction catalyst.

11. A dual loop EGR system adapted for use with an internal combustion engine with an exhaust manifold including an exhaust outlet and an intake manifold including an air inlet, the system comprising:

a high pressure EGR loop in fluidic connection with the exhaust outlet of the exhaust manifold and the air inlet of the intake manifold;

a turbocharger including an exhaust gas turbine and a compressor with an input and an output;

an exhaust emissions controller downstream of the exhaust gas turbine, with a first portion of a low pressure EGR loop in fluidic connection with the exhaust emissions controller and the input of the compressor; and

a second portion of a low pressure EGR loop in fluidic connection with the output of the compressor and the air inlet of the intake manifold.

12. The dual loop EGR system of claim 11, further comprising a first control valve for controlling flow of exhaust through the high pressure EGR loop and a second control valve for controlling flow of exhaust through the first portion of the low pressure EGR loop.

13. The dual loop EGR system of claim 11, further comprising an EGR cooler disposed along the high pressure EGR loop.

14. The dual loop EGR system of claim 11, further comprising an air cooler disposed along the second portion of the low pressure EGR loop.

16. The dual loop EGR system of claim 12, further comprising a control, the control operating the first control valve and the second control valve.

17. The dual loop EGR system of claim 11, wherein the turbocharger comprises a variable geometry turbocharger.

18. A method for controlling EGR in an internal combustion engine with an exhaust manifold including an exhaust outlet and an intake manifold including an air inlet, the method comprising the steps of:

providing a high pressure EGR loop with an EGR cooler and a first control valve, the high pressure EGR loop being in fluidic connection with the exhaust outlet of the exhaust manifold and the air inlet of the intake manifold;

providing a turbocharger including an exhaust gas turbine with an exhaust emissions controller downstream of the turbine and a compressor with an input and an output;

providing a first portion of a low pressure EGR loop with a second control valve in fluidic connection with the exhaust emissions controller and the input of the compressor and a second portion of a low pressure EGR loop in fluidic connection with the output of the compressor and the air inlet of the intake manifold; and

controlling the first control valve and the second control valve such that the EGR source is the high pressure EGR loop, the low pressure EGR loop, or a combination thereof.

19. The method of claim 18, wherein under low engine load conditions the primary source of EGR is the low pressure EGR loop and under high engine load conditions the primary source of EGR is the high pressure EGR loop.

20. The method of claim 18, wherein condensation within the engine is minimized under high condensation conditions by maintaining the low pressure EGR loop as the primary source of EGR at engine load conditions that exceed the engine load conditions at which the EGR source is switched from the low pressure EGR loop to the high pressure EGR loop during normal or low condensation conditions.